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Application Number 10/634,330

Filing Date August 4, 2003

First Named Inventor Harald Kloeckner

Group Art Unit 1762

Examiner Name Elena Tsoy

Total Number of Pages in This Submission

39

Attorney Docket Number

FA1144 US NA

ENCLOSURES (check all that apply)

☒ Fee Transmittal Form

☐ Fee Attached

☐ Amendment / Response

☐ After Final

☐ Affidavits/declaration(s)

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☐ Certified Copy of Priority Document(s)

☐ Response to Missing Parts/
Incomplete Application

☐ Response to Missing
Parts under 37 CFR
1.52 or 1.53

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July 12, 2006

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Patent fees are subject to annual revision.

☐ Applicant Claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT (\$) 500.00

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Application Number	10/634,330
Filing Date	AUGUST 4, 2003
First Named Inventor	HARALD KLOECKNER
Examiner Name	ELENA TSOY
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Attorney Docket No.	FA1144 US NA

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106	430	206	215	Design filing fee	
107	660	207	330	Plant filing fee	
108	1400	208	700	Reissue filing fee	
114	200	214	100	Provisional filing fee	
SUBTOTAL (1)					(\$)

2. EXTRA CLAIM FEES

Total Claims -20 = 0 X 50 = 0
Independent Claims -3 = 0 X 200 = 0
Multiple Dependent ☐ X 360 =

Large Entity		Small Entity		Fee Description
Fee Code	Fee (\$)	Fee Code	Fee (\$)	
103	50	203	25	Claims in excess of 20
102	200	202	100	Independent claims in excess of 3
104	360	204	180	Multiple dependent claim, if not paid
109	200	209	100	** Reissue independent claims over original patent
110	50	210	25	** Reissue claims in excess of 20 and over original patent
SUBTOTAL (2)				(\$)

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FEE CALCULATION (continued)

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Fee Code	Fee (\$)	Fee Code	Fee (\$)		
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	120	215	60	Extension for reply within first month	
116	450	216	225	Extension for reply within second month	
117	1020	217	510	Extension for reply within third month	
118	1,590	218	795	Extension for reply within fourth month	
128	2,160	228	1,080	Extension for reply within fifth month	
119	500	219	250	Notice of Appeal	
120	500	220	250	Filing a brief in support of an appeal	500.00
121	1000	221	500	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	500	240	250	Petition to revive - unavoidable	
141	1,500	241	750	Petition to revive - unintentional	
142	1,400	242	700	Utility issue fee (or reissue)	
143	800	243	400	Design issue fee	
144	100	244	550	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Processing fee under 37 CFR 1.17(q)	
126	180	126	180	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	790	246	395	Filing a submission after final rejection (37 CFR § 1.129(a))	
149	790	249	395	For each additional invention to be examined (37 CFR § 1.129(b))	
179	790	279	395	Request for Continued Examination (RCE)	
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SUBMITTED BY

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Application Number: 10/634,330
Filing Date: August 4, 2003
First Named Inventor: Harald Kloeckner
Title: Method for Painting Plastic Substrates
Attorney Docket No: FA1144 US NA

- Transmittal Form
- Fee Transmittal
- Appeal Brief
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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Harald Kloeckner et al.

CASE NO: FA1144 US NA

SERIAL NO: 10/634,330

GROUP ART UNIT: 1762

FILED: August 4, 2003

EXAMINER: E. TSOY

FOR: METHOD FOR PAINTING PLASTIC
SUBSTRATES

APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Pursuant to 37 C.F.R. § 1.192, the following is an Appeal Brief in support of the Appeal filed May 12, 2006, appealing the Final Office Action dated January 18, 2006. Submitted herewith is the filing fee for this Appeal Brief in accordance with 37 C.F.R. § 41.20(b)(2). Please charge said fee to Deposit Account No. 04-1298 (E.I. du Pont de Nemours and Company).

07/18/2006 MBELETE1 00000086 041928 10634330

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TABLE OF CONTENTS

I. REAL PARTY IN INTEREST.....	3
II. RELATED APPEALS AND INTERFERENCES.....	3
III. STATUS OF THE CLAIMS.....	3
IV. STATUS OF AMENDMENTS	3
V. SUMMARY OF CLAIMED SUBJECT MATTER.....	3
VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL	5
VII. ARGUMENT	6
A. The Final Office Action	6
B. The Advisory Action	7
C. Applicants' Traversal of the Final Office Action and Arguments in Support Thereof	8
1. Claims 2-6, 8, 10-15, 17 and 18 are Nonobvious over Hellmann et al. in view of Ozawa et al., further in view of Shiraishi et al.	8
2. Claims 3, 12-15, 17 and 18 are Nonobvious over Shiraishi et al. in view of Ozawa et al.	17
3. Claims 2, 4 -6, 8, 10 and 11 are Nonobvious over Shiraishi et al. in view of Ozawa et al. further in view of Hellmann et al.....	18
4. Claims 9 and 16 are Nonobvious over Hellmann et al. in view of Ozawa et al. in view Shiraishi et al. in view of Ozawa et al. further in view of Heaps et al. and Corcoran et al.	19
VIII. CONCLUSION	20
CLAIMS APPENDIX.....	21
EVIDENCE APPENDIX.....	26
RELATED PROCEEDINGS APPENDIX	27

I. REAL PARTY IN INTEREST

The real party in interest is E.I. du Pont de Nemours and Company (*hereinafter* "DuPont"), owner of the Application.

II. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences known to Applicants, Applicants' legal representative, or DuPont that will directly affect or be directly affected by or have a bearing on the Board of Patent Appeals and Interferences' (*hereinafter* the "Board") decision in the present Appeal.

III. STATUS OF THE CLAIMS

Claims 2-6 and 8-18 stand rejected and are the subject of this Appeal. Originally-filed claims 1 and 7 have been canceled.

IV. STATUS OF AMENDMENTS

In the amendment dated March 21, 2006 under 37 CFR 1.116 in reply to the Final Office Action mailed on January 18, 2006 (*hereinafter* Final Office Action), Claims 2 and 3 were amended and the amendment was entered by the Examiner in the Advisory Action, mailed April 4, 2006, page 2, paragraph 2. On June 28, 2006 under 37 CFR 41.33 an amendment was filed wherein Claims 2 and 3 were amended. In Claim 2, first line of subparagraph B) and in Claim 3 first line of subparagraph B, "the" was amended to – an – since there was no proper antecedent basis for "the", thus placing the claims in better form for consideration on appeal.

V. SUMMARY OF CLAIMED SUBJECT MATTER

Claims 2 and 3 are the independent claims at issue. Claim 2 relates to a method for painting plastic substrates, comprising the steps: (see page 1, lines 5-6, page 3, lines 13-14 and page 4, lines 12-14); 1. applying a base coat layer consisting of a colour-and/or effect-imparting base coat directly to the plastic substrate, (see page 3, lines 15 and 16, page 4, lines 15 and 16 and page 10, lines 24-27); 2. evaporating and/or curing the base coat layer thus obtained, (see page 3, line 18, page 4, line 17, page 10, line 30 - page 11, line 1); 3. applying a clear coat

layer consisting of a transparent clear coat to the base layer obtained, (see page 4, line 18, page 11 line 1 – 2); 4. curing the clear coat layer obtained, optionally together with the base coat, wherein the applied color-and/or effect-imparting base coat comprises (see page 4, lines 19 – 20, page 11, lines 2-3); A) 30 to 90% by weight of a conventional base coat composition, comprising (see page 4 line 22 – 23); Aa) at least one binder selected from the group consisting of (see page 3, line 24 and page 4, line 24) polyurethane, acrylated polyurethane, polyacrylate, polyester, acrylated polyester and alkyd resins and any combination thereof, (see page 6, lines 5 – 7); Ab) at least one colour and/or effect pigment, (see page 3, line 25 and page 7, line 10 – 11); Ac) at least one organic solvent and/or water and (see page 4, line 26 and page 7, lines 26 – 27); Ad) optional conventional paint additives (see page 4, line 27); B) 10 to 70% by weight of an adhesion-promoting composition B) comprising (see page 4, line 28-29); Ba) at least one ethylene vinyl acetate copolymer, (see page 8, lines 25 – 26 and page 9, lines 3 – 5); Bb) at least one chlorinated rubber, (see page 8, lines 27 – 28 and page 9, lines 11 – 13); Bc) at least one chlorinated polyolefin and (see page 8, lines 29 – 30 and page 9, line 24); Bd) optionally organic solvent and/or water and conventional paint additives (see page 8, lines 31 – 32); wherein the sum of the portions of components A) and B) makes up 100% by weight: (see page 4, lines 30 – 31); wherein step (1) of applying the base coat layer consisting of a colour- and/or effect-imparting coating composition consists of applying a colour- and/or effect-imparting coating composition containing the adhesion-promoting composition B) directly to the plastic substrate and subsequently applying a layer of a colour-and/or effect-imparting coating composition which does not contain the adhesion-promoting composition B); (see page 11, line 26 – page 12, line 1.

Claim 3 relates to a method for painting plastic substrates, comprising the steps: (see page 1, lines 5- 6, page 3, lines 13-14, page 5, lines 1 – 2); 1. applying a pigmented monocoat finish layer consisting of a color-and/or effect-imparting coating composition directly to the plastic substrate and (see page 5, lines 4 - 5); 2. curing the top coat layer thus obtained, (see page 5, line 6); wherein the applied color-and/or effect imparting monocoat finish comprises (see page 5, lines 8 – 9); A) 30 to 90% of a conventional monocoat finish composition, comprising (see page 5,

lines 8 - 9); Aa) at least one binder selected from the group consisting of (see page 5, line 10) polyurethane, acrylated polyurethane, polyacrylate, polyester, acrylated polyester and alkyd resins and any combinations thereof, (see page 6, line 5 – 7); Ab) at least one color and/or effect pigment, (see page 5, line 11); Ac) at least one organic solvent and/or water and (see page 5, line 12); Ad) optionally conventional paint additives and (see page 5, line 13); B) 10 to 70% by weight of an adhesion-promoting composition B), comprising (see page 5, lines 14-15); Ba) at least one ethylene vinyl acetate copolymer, (see page 8, line 25 – 26 and page 9, lines 3 – 5); Bb) at least one chlorinated rubber, (see page 8, lines 27 – 28 and page 9, lines 11-13); Bc) at least one chlorinated polyolefin and (see page 8, lines 29 – 30 and page 9, line 24); Bd) optionally organic solvents and/or water and conventional paint additives, (see page 8, lines 31 – 32); wherein the sum of the portions of components A) and B) makes up 100% by weight; (see page 5, lines 16 – 17) wherein step (1) of applying a pigmented monocoat finish layer consisting of a colour-and/or effect-imparting coating composition consists of applying a color-and/or effect-imparting coating composition containing the adhesion-promoting composition B) directly to the plastic substrate and subsequently applying a layer of pigmented monocoat finish layer consisting of a color-and/or effect-imparting coating composition which does not contain the adhesion-promoting composition B) (see page 11, line 26 – page 12, line 1 and page 13, lines 19-23).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Whether claims 2-6, 8, 10 – 15, 17 and 18 are obvious under 35 U.S.C. § 103(a) in view of Hellmann *et al.* (U.S. Patent No. 5,421,000) in view of Ozawa *et al.* (U.S. Patent No. 5,492,963), further in view of Shiraishi *et al.* (U.S. Patent No. 6,670,414).

Whether claims 3, 12-15, 17 and 18 are obvious under 35 U.S.C. § 103(a) over Shiraishi *et al.* in view of Ozawa *et al.*

Whether claims 2, 4-6, 8, 10 and 11 are obvious under 35 U.S.C. § 103(a) over Shiraishi *et al.* in view of Ozawa *et al.* further in view of Hellmann *et al.*

Whether claims 9 and 16 are obvious under 35 U.S.C. § 103(a) over Hellmann *et al.* in view of Ozawa *et al.* in view Shiraishi *et al.* in view of Ozawa *et al.*

further in view of Heaps *et al.* (U.S. Patent No. 4,517,327) and Corcoran *et al.* (U.S. Patent 5,279,862).

VII. ARGUMENT

A. The Final Office Action.

Claims 2-8, 10-15, 17 and 18 were rejected as being obvious under 35 U.S.C. § 103(a) over Hellmann *et al.*, in view of Ozawa *et al.* further in view of Shiraishi *et al.* The Examiner asserted that these remained rejected as stated in the July 26, 2005, Non-Final Office Action (*hereinafter* "NF Office Action"). In the NF Office Action, the Examiner argued that Hellmann *et al.* disclosed a method for painting plastic substrates of motor vehicles with a pigmented coating composition which contained ethyl/vinyl acetate copolymers, chlorinated polyolefins, epoxy resins, organic solvents, and optional paint auxiliaries, pigments and/or fillers and that Ozawa *et al.* taught that chlorinated natural and synthetic rubbers provide excellent film forming properties including adhesion and it would have been obvious to combine the teaching of Hellmann *et al.* with the teachings of Ozawa *et al.* (see NF Office Action, paragraph 2, pages 2 – 3). In an amendment filed November 21, 2005 in response to the NF Office Action, Applicants amended the independent claims 2 and 3 to define the binder Aa) as "at least one binder selected from the group consisting of polyurethane, acrylated polyurethane, polyacrylate, polyester, acrylated polyester and alkyd resins and any combinations thereof" since Hellmann *et al.* only disclosed the use of epoxy resins.

In the Final Office Action, the Examiner recognized that Hellmann *et al.* and Ozawa *et al.* failed to teach that the binder could be the polymer set forth in the amended claims and then cited Shiraishi *et al.* that showed a similar list of polymers including epoxy resins and held that it would have be obvious to one skilled in the art to use the polymers of Shiraishi *et al.* as binders in the coating compositions of Hellmann *et al.* and Ozawa *et al.* (see Final Office Action paragraph 3, pages 2-3).

In the Final Office Action, claims 3, 12-15, 17 and 18 were rejected under 35 U.S.C. 103 (a) as being unpatentable over Shiraishi *et al.* in view of Ozawa *et al.* on the basis that Shiraishi *et al.* disclosed a method for coating plastic parts by applying a pigmented binder composition and that Ozawa *et al.* taught the use of chlorinated

rubbers in coating compositions (see Final Office Action, paragraph 4, pages 3 and 4).

Claims 2, 4-8, 10, 11 in the Final Office Action were rejected under 35 U.S.C. 103(a) as being unpatentable over Shiraishi *et al.* in view of Ozawa *et al.* further in view of Hellmann *et al.* Shiraishi *et al.* in view of Ozawa *et al.* were applied for the same reasons given above and Hellmann *et al.* was stated to teach that after drying/curing a primer coating layer a typical finishing paint may be applied and cured including a clear top coat (see Final Office Action paragraph 5, page 5).

In the Final Office Action, Claims 9 and 16 were rejected under 35 U.S.C. 103 (a) as being unpatentable over of Hellmann *et al.* in view of Ozawa *et al.* in view of Shiraishi *et al.* further in view of Heaps *et al.* (U.S. Patent 4,517,327) and Corcoran *et al.* (U.S. Patent 5,279,862). Hellmann *et al.*, Ozawa *et al.* and Shiraishi *et al.* were applied for the same reasons as above. It was recognized that none of these references taught that color imparting coating composition was a water based composition. Heaps *et al.* was held to show that because of environmental concerns today solvent based coatings are being converted to water based coatings and that it would be obvious to use a water based coating in the Hellmann *et al.*, Ozawa *et al.* and of Shiraishi *et al.* combination of references. Corcoran *et al.* was held to teach that solvent or water based clear coatings can be applied as base coats and it would be expected that water based coating compositions would be operative in the Hellmann *et al.*, Ozawa *et al.*, Shiraishi *et al.* combination of references (see Final Office Action, paragraph 6, pages 5-7).

B. The Advisory Action

In the Advisory Action mailed April 4, 2006 (*hereinafter* "Advisory Action") in response to Applicants' amendment filed on March 24, 2006 under 37 CFR 1.116 responding to the Final Office Action, the amendment to Claims 2 and 3 was entered by the Examiner (see Advisory Action, page 2, 1st par. lines 1 and 2). The amended Claims 2 and 3 were rejected as being obvious in view of Hellmann *et al.* as cited in the Final Office Action. Specifically, the Examiner stated Hellmann *et al.* taught a three coat finishing process erroneously equating the primer layer of Hellmann *et al.* to a color coat layer thereby teaching the claimed process of Claim 2 of two color base coats and a clear coat and Claim 3 of two pigmented mono coat finish layers

(see Advisory Action, page 2, paragraph 1). Applicants arguments in response to the Final Rejection were held to be non-persuasive and Claims 2-6 and 8-18 remained rejected.

C. Applicants' Traversal of the Final Office Action and Advisory Office Action and Arguments in Support Thereof

1. Claims 2-6, 8, 10-15, 17 and 18 are Nonobvious over Hellmann *et al.* in view of Ozawa *et al.*, further in view of Shiraishi *et al.*

To fully understand Applicants invention a brief explanation of the advance in the art that has been made is provided. Plastic substrates, such as, polypropylene substrates, are widely used by the automobile industry for a variety of auto and truck parts; such as, bumper panels, spoilers, wheel housing panels, etc. To provide an acceptable level of adhesion of the paint to such substrates, a primer coating layer containing adhesion promoters has been applied and then the top coating layer(s) containing the colored pigments that match the color of the coating to the other parts of the auto or truck or layers are applied. The top coating can be a single layer (mono coat containing pigments) or a base coat (containing pigments) and clear coat layer. The advance that Applicants have made in the claimed process (Claims 2 and 3) is to eliminate the primer coating layer and applying the base coat layer or mono coat layer directly to the plastic substrate while achieving acceptable adhesion to the plastic substrate. This is accomplished by properly formulating the base coat or mono coat with an adhesion promoting composition comprising a mixture of at least one ethylene vinyl acetate copolymer, at least one chlorinated rubber and at least one chlorinated polyolefin. Applicants process also provides for the application of a second base coating layer that does not contain an adhesion promoting composition over the first base coating then applying a clear coat layer to provide a finish having an improved depth of color to the plastic substrate (Claim 2). Similarly, Applicants' invention also provides for a process for the application of a second mono coat layer that does not contain an adhesion promoting composition to the first mono coating layer containing the adhesion promoter composition thereby also providing a finish to the plastic substrate having improved depth of color (Claim 3).

Elimination of a coating layer such as, in this case, the primer coating layer in a vehicle painting process provides for significant cost and time savings and represents a major economic advantage to the vehicle manufacturer and is considered a very important advance in the art. The application of a second base coating layer or mono coating layer provides for improved appearance that is an important factor in the sales of vehicles.

The following are provided to illustrate the invention:

Claim 2 is directed to a process for painting plastic substrates that forms the following coated plastic structure:

Clear top coat layer
Base coat layer without adhesion promoting composition
Base coat layer containing adhesion promoting composition
Plastic substrate

Claim 3 is directed to a process for painting plastic substrates that forms the following structure:

Mono coat layer without adhesion promoting composition
Mono coat layer containing adhesion promoting composition
Plastic substrate

In contrast, the prior art processes form the following structures:

Clear top coat layer
Base coat layer without adhesion promoting composition
Primer layer
Plastic substrate

and

Mono coat layer without adhesion promoting composition
Primer layer
Plastic substrate

Throughout the prosecution of the application, the Examiner has continuously erred by taking the position that there is no difference between a primer, a base coat or a mono coat. The Examiner stated

One of ordinary skill in the car painting art knows that a base coat and a primer are used interchangeably, e.g. a

basecoat applied directly to a substrate is a primer,.....or the same coating composition pigmented with conventional pigments can be used as monocoat or as basecoat or as a primeror a primer applied directly to a substrate is a basecoat.
(See Advisory Action page 3, paragraph 3 A, emphasis was provided by the Examiner).

One cannot equate primers, base coats and top coats. Each perform a completely different function in a multilayer coating.

"Primer" is defined as "First complete coat of paint of a painting system applied to a surface. Such paints are designed to provide adequate adhesion to new surfaces and are formulated to meet the special requirements of the surface. The type of primer varies with the surface, its condition, and the total painting system to be used." (Paint/Coatings Dictionary Published by Federation of Societies for Coatings Technology, 1978, p 344).

To help understand terms of art used in the coating industry, the following two documents have been attached for the Board's review:

Automotive Paints and Coatings, Edited by G. Fettis, VCH publication (1st edition), pages 120 and 121 and

Ullmann's Encyclopedia of Industrial Chemistry (5th Edition, Vol. A, pp 517-519).

(These documents were provided to the Examiner in the Response to the Non-Final Office Action dated Nov. 17, 2005 and are attached in the Evidence Appendix.)

In the Automotive Paints and Coatings document, the various layers of a typical multi-layer automotive coating are set forth. As can be seen these various layers are clearly identified. In particular, Fig. 5-1 pictorially shows the various layers for a metal substrate and in particular, the primer layer, the primer surfacer layer and the basecoat and clear coat layers. For plastic substrates, a slightly different multilayer configuration is used. A primer layer is applied to the plastic substrate and then a topcoat layer or a combination of a base coat layer and a clear coat layer are then applied. A primer surfacer layer typically is not used. The primer layer provides adhesion to the plastic substrate and a smooth surface to which the top coat layer or

base coat/clear coat layers can be applied and does not contain pigments that are of the same color as the basecoat layer but are usually black, gray or white in color. The basecoat layer is the color providing layer of the multi-layer coating which is not sanded or treated in any manner but is top coated with a clear protective layer. Similarly, the topcoat layer is the color providing layer which does not have a clear layer applied thereto. Each of the layers of a multi-layer coating have a special purpose and are significantly different from each other.

Ullmann, in par, 11.2, similarly discusses multi-layer automotive paint coatings and shows multi-layer paint coatings used on automobiles comprise primers, intermediate coats (also called fillers or surfacers) and top coats which presently comprise a basecoat and a clear coat which is the most popular top coat used on automobiles today. The clear topcoat provides a full deep gloss (wet look), highly brilliant metallic effects, long lasting resistance against weathering and chemicals, and is easy to polish and repair.

The plain meaning of a claim term “refers to the ordinary and customary meaning give to the term by those of ordinary skill in the art”. MPEP § 2111.01(II). The above discussion and references clearly show that the terms “primer” and “base coat” have separate and distinct meanings in the coating art and cannot be used interchangeably.

In the Advisory Action, (page 3, par. 3 (A)), the Examiner in an effort to support the position that the terms “basecoat and primer” can be used interchangeably, cited *Faul et al.* (U.S. Patent 5,258,460, col. 3, line 58). A fair reading of *Faul et al.* shows that the term “basecoat primers” is intended to mean “primers” which are formulated from amino-epoxy resins cathodically deposited on a substrate. *Scopazzi et al.* (U.S. Patent 5,859,136, col. 3, lines 39-42) was also cited. *Scopazzi et al.* actually supports the position that the terms are separate and distinct. “Generally, the novel coating composition is used as a clear coat but can be pigmented with conventional pigments and used as monocoat or as a basecoat or as a primer.” *Id.* *Scopazzi et al.* clearly points out that a monocoat, a basecoat and a primer are separate and distinct coating layers. *Muller* (U.S. Patent 4,572,792, col. 3, line 8) was also cited but the term “primer (basecoat)” referred to by *Muller* means

a “primer”. Example 1 of Muller (col. 3, line 59 – col. 4, line 2) shows a primer of a polysulfide was applied and then a top coat of a polyurethane was applied to a test panel and does not support the proposition that primers and basecoats are interchangeable terms. The terms “basecoat and primer” cannot be used interchangeably. These are clear and distinct terms having an established meaning to those skilled in the coating art.

Hellmann *et al.*

Hellmann *et al.* is directed toward primers that are applied to the plastic substrate. This is the layer that Applicants’ process has been able to omit by the use of a properly formulated topcoat or base coat layer. Since Hellmann is directed to primers, Hellmann uses adhesion promoting components and epoxy resins as a binder component. *Id.* at col. 1, line 64 – col. 2 line 8. Epoxy resins cannot be used as topcoats or base coats since these resins are readily degraded by UV light. Applicants’ claims are directed to the use of only binder components that are stable to UV light exposure and weathering. The binder components set forth in the claims (Claim 2 A) and Claim 3 A)) are selected from the group consisting of polyurethane, acrylated polyurethane, polyacrylate, polyester, acrylated polyester or alkyd resin and do not include epoxy resins. This is contrary to the Examiners allegation that the binder of Applicants’ composition can contain epoxy resins (Advisory Action page 3, par. 3(B)).

To provide a durable and color acceptable vehicle finish, the primer layer of Hellmann *et al.* has to be overcoated with another coating layer. Firstly, primers do not contain the pigments that are required to provide the desired color to the painted plastic part, and secondly Hellmann is directed to primers containing an epoxy resin that must be overcoated since it is not a durable topcoat vehicle finish. Applicants process has eliminated the primer layer that is required by Hellmann *et al.* and also provide for the application of a second basecoat (Claim 2) or a second topcoat (Claim 3) over the first coat to provide additional depth of color to the coating

composition. This is not taught or suggested by Hellmann *et al.* or any of the other references cited by the Examiner.

Ozawa *et al.*

The second important constituent of the coating composition used in Applicants' process is the adhesion promoting composition B) which comprises ethylene vinyl acetate copolymer, chlorinated rubber and chlorinated polyolefin. As recognized by the Examiner, Hellmann *et al.* does not teach the use of a chlorinated rubber which is a necessary component of Applicants' composition used in the processes as claimed. (See NF Office Action, page 3, lines 3-4). For this component, the Examiner reaches out to Ozawa *et al.* to show that chlorinated rubbers are useful. However, Ozawa *et al.* states the following:

It has presently been unexpectedly discovered that chlorinated polyolefins have significantly high chlorine contents can be utilized in adhesive compositions so as to provide performance equivalent to or greater than the performance provided by the traditional chlorinated rubber materials utilized in adhesive compositions. *Id.* Col. 2, lines 3-8.

Such a teaching by Ozawa *et al.* certainly would direct one skilled in the art to eliminate the chlorinated rubber component but this is a necessary component of the coating composition utilized in Applicants' processes as claimed. Ozawa *et al.* leads one skilled in the art away from the use of chlorinated rubber.

The Examiner made a completely wrong interpretation of these teachings of Ozawa *et al.* (See NF Office Action rejection page 3, 2nd. par.) Ozawa *et al.*, teaches that adhesive compositions based on chlorinated polyolefins having a chlorine content of 60% provide a better performance than traditional chlorinated rubbers (see Ozawa, col. 2 lines 3 – 16). This means that chlorinated polyolefines have been substituted for chlorinated rubbers and not the other way around as suggested by the Examiner. The chlorinated polyolefins according to Ozawa *et al* show better metal – wetting capability than commercial chlorinated polyolefins having a chlorine content of less than 60%. Nothing at all is taught by Ozawa *et al.* of the fact that the use of chlorinated rubber leads to improved adhesion to plastics of coatings in comparison to the usual commercially available chlorinated polyolefins. Ozawa *et al.*

teaches that chlorinated polyolefins should be substituted for chlorinated rubbers. As pointed out, chlorinated rubber are a necessary for the adhesion promoting component of the composition used in Applicants' claimed process for the multilayer coating of plastic substrates.

Further, Ozawa *et al.* is directed to adhesives and is not related to coatings and does not mention or suggest coating of plastics with a multilayer composition which is Applicants' invention as set forth in Claims 2 and 3. Ozawa *et al.* is concerned with providing rubber to metal adhesives for bonding elastomeric materials, such as, vulcanized elastomers to metal surfaces. *Id.* col. 1, line 65 – col. 2, line 3. This adhesive field of technology is far from the technical field of the coatings art for application of multilayer coatings to plastic substrates and is non-relevant art. One skilled in the coatings art would not look to a reference to solve a coating problem that is not related to coatings and contains no teachings or suggestions for the modification of coatings. To combine references as has been done there must be at least some motive to combine outside of the teaching of Applicants' specification and here there is none.

The teachings or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). MPEP 2143.

Shiraishi *et al.*

Shiraishi *et al.* is directed to binder resin composition for protecting or enhancing the appearance of polyolefin substrates. The binder composition comprises a carboxyl group containing chlorinated polyolefin and a vinyl acetate copolymer and can contain a variety of resins, such as, alkyd resins, acrylic resins and the like to balance physical properties of the coated film or adhesive. However, Shiraishi *et al.* does not show or suggest Applicants' novel process wherein two basecoats are applied directly to a plastic substrate without the use of a primer layer wherein the first basecoat contains the adhesion promoting composition of ethylene vinyl acetate copolymer, chlorinated rubber and chlorinated polyolefin and the second layer is identical to the first layer but does not contain the adhesion

promoting composition. A clear coat layer is then applied (Claim 2). The process of Claim 3 is identical to Claim 2 except a clear coat layer is not applied.

Further, Shiraishi *et al.* does not disclose the use of chlorinated rubber which is a necessary component of the adhesion promoting composition of the coating composition used in Applicants' process. Also, the chlorinated polyolefin used by Shiraishi *et al.* contains carboxyl groups. *Id.* col. 3, lines 9-21. The chlorinated polyolefin used in the coating composition of Applicants' process does not contain carboxyl groups.

Prima Facie Case of Obviousness

Section 2142 of the MPEP indicates that a *prima facie* case of obviousness can only be established when:

- (1) all of the claim limitations are either taught, or suggested by the cited prior art;
- (2) there is some suggestion or motivation to modify or combine the cited prior art references; and
- (3) there is reasonable expectation of successfully producing the claim invention via such a combination that is not base on Applicants' disclosure.

None of the above three prongs of a *prima facie* case of obviousness are satisfied by the combination of the cited references of Hellmann *et al.*, Ozawa *et al.* and Shiraishi *et al.* as has been pointed out above.

All of the limitations of the claims are not taught by the cited references. None of the reference teach or suggest the application of a second color base coat layer over a first base coat layer (Claim 2) nor the application of a second pigmented mono coat layer over the first pigmented mono coat layer (Claim 3) wherein the second layer in each case does not contain the adhesion promoting composition. In an attempt to show this second layer, Hellmann *et al.* was cited but a fair reading of col. 3, lines 17-29 of Hellmann *et al.* shows that the primer of Hellmann *et al.* is the first layer applied and subsequent layers can be coatings of any composition. Certainly there is no teaching that the second layer is the identical composition

without the presence of the adhesion promoter composition as is required by Applicants' process. As pointed out previously, the application of a subsequent or second pigmented layer adds to the depth of color of the coating and significantly improves appearance.

Further, none of the references teach the use of the chlorinated rubber component that is a necessary constituent of the adhesion promoting composition used in Applicants' coating composition. Ozawa *et al.* was cited but is directed to adhesive compositions for metal substrates and as pointed out above actually teaches away from using this component and suggests the use of chlorinated polyolefin in its place. Based on this there is no motivation to combine the teachings of Ozawa *et al.* with Hellmann *et al.* and Shiraishi *et al.* Further, Shiraishi *et al.* does not teach the use of chlorinated rubber but only carboxyl group containing chlorinated polyolefins.

Based on the teaching of Ozawa *et al.* there cannot be a reasonable expectation of success since Ozawa *et al.* teaches away from the use of the chlorinated rubber component. Therefore, if the teaching of Ozawa *et al.* were combined with the other reference as suggested by the Examiner, the composition used in Applicants' process would not be formed since it would not have one of the necessary component, i.e., chlorinated rubber. Further, there cannot be an expectation of success since none of the references teach the second layer of coating applied over the first layer applied to the plastic substrate. One skilled in the art could not possibly arrive at Applicants invention based on the teachings of the above cited references without the use of Applicants' disclosure.

[I]mpermissible hindsight must be avoided and the legal conclusion must be reached on the basis of the facts gleaned from the prior art. MPEP 2142.

Based on the above arguments, Applicants submit that Claim 2 and 3 are unobvious and patentable over Hellmann *et al.* in view of Ozawa *et al.* further view of Shiraishi *et al.*

Because Claims 4-6, 8-11 are dependent on Claim 2 and recite further limitation for Claim 2 and Claims 12-18 are dependent on Claim 3 and recite further limitations for Claim 3, Applicants rely upon the arguments presented above in the

rebuttal to the Examiner's assertion that Claims 4-6, 8, 10-15, 17 and 18 are obvious over Hellmann *et al.* in view of Ozawa *et al.* further view of Shiraishi *et al.*

2. Claims 3, 12-15, 17 and 18 are Nonobvious over Shiraishi *et al.* in view of Ozawa *et al.*

Claim 3 is directed to a process for coating a plastic substrate by applying a first pigmented monocoat layer directly to a plastic substrate and then applying a second pigmented monocoat layer that does not contain the adhesion promoting composition (B) to the first layer. Claim 3 and dependent Claims 12-15, 17 and 18 were rejected over Shiraishi *et al.* in view of Ozawa *et al.* The patentable differences between the Shiraishi *et al.* and Ozawa *et al.* references are discussed above and will not be set forth again.

A *prima facie* case of obviousness has not been made for these claims based on Shiraishi *et al.* and Ozawa *et al.* As pointed out above, not all the claims' limitations are taught. Neither Shiraishi *et al.* nor Ozawa *et al.* show or suggest the application of a second pigmented mono coat layer that does not contain the adhesion promoting composition over the first pigmented mono coat layer containing the adhesion promoting composition that has been applied directly to the plastic substrate. Neither Shiraishi *et al.* nor Ozawa *et al.* teach the use of chlorinated rubber as one of the adhesion promoting components which Applicants require in the first pigmented mono coat that is applied to the plastic substrate. Ozawa *et al.* actually teaches away from using the chlorinated rubber component and is primarily directed to adhesive for metals so that there is no suggestion or motivation to combine the teachings of Ozawa *et al.* with Shiraishi *et al.* Shiraishi *et al.* only teaches the use of chlorinated polyolefins containing carboxyl groups. In view of the above, there can be no reasonable expectation of producing Applicants' invention via the combination of these references unless Applicants' disclosure was used along with hindsight reasoning.

In view of the above arguments and that Claims 12 -15, 17 and 18 are dependent from Claim 3 and recite further limitations for Claim 3, Applicants submit that all of these claims are unobvious and patentable over Shiraishi *et al.* in view of Ozawa *et al.*

3. Claims 2, 4-6, 8, 10 and 11 are Nonobvious over Shiraishi *et al.* in view of Ozawa *et al.* further in view of Hellmann *et al.*

Claim 2 is directed to a process for coating a plastic substrate by applying a first pigmented base coat layer directly to a plastic substrate without the use of a primer layer and then applying a second pigmented base coat layer that does not contain the adhesion promoting composition (B) to the first layer and then applying a transparent clear coat layer thereto. Claim 2 and dependent Claims 4-6, 8, 10 and 11 were rejected over Shiraishi *et al.* in view of Ozawa *et al.* further in view of Hellmann *et al.* The patentable differences of Shiraishi *et al.*, Ozawa *et al.* and Hellmann *et al.* references are discussed above and will not be set forth again.

A *prima facie* case of obviousness has not been made for these claims based on the citation of Hellmann *et al.*, Shiraishi *et al.* and Ozawa *et al.* As pointed out above not all the claims limitations are taught.

None of the reference teach or suggest the application of a second pigmented color base coat layer that does not contain the adhesion promoting composition over a first base coat layer. Hellmann *et al.* was cited but a fair reading of col. 3, lines 17-29 of Hellmann *et al.* shows that the primer of Hellmann *et al.* is the first layer applied and subsequent layers can be coatings of any composition. Certainly there is no teaching in Hellmann *et al.* that the second layer is the identical composition without the presence of the adhesion promoter composition as is required by Applicants' process. As pointed out previously, the application of a subsequent or second pigmented color base coat layer adds to the depth of color of the coating and significantly improves appearance.

None of the references teach the use of the chlorinated rubber component that is a necessary constituent of the adhesion promoting composition used in Applicants' coating composition that is applied directly to the plastic substrate. Ozawa *et al.* is directed to adhesive compositions for metal substrates and as pointed out above actually teaches away from using this component and suggest the use of chlorinated polyolefin in its place. Based on this there is no motivation to combine the teachings of Ozawa *et al.* with Hellmann *et al.* and Shiraishi *et al.* Further, Shiraishi *et al.* does not teach the use of chlorinated rubber but only carboxyl group containing chlorinated polyolefins.

Based on Ozawa *et al.* there cannot be a reasonable expectation of success since Ozawa *et al.* teaches away from the use of the chlorinated rubber component. Therefore, if the teaching of Ozawa *et al.* were combined with the other reference, the coating composition used in Applicants' process would not be formed since it would not have one of the necessary components, i.e., chlorinated rubber. Further, there cannot be success since none of the references teach the second layer of coating applied over the first layer applied to the plastic substrate. One skilled in the art could not possibly arrive at Applicants' invention based on the teachings of the above cited references without the use of Applicants' disclosure.

Claim 2 and the corresponding dependent claims require the application of a clear coat layer over the second pigmented base coat layer. Shiraishi *et al.* is directed only to mono coat compositions and does not mention the application of a clear coat layer.

In view of the above arguments and that Claims 4-6, 8, 10 and 11 are dependent from Claim 2 and recite further limitations for Claim 2, Applicants submit that all of these claims are unobvious and patentable over Hellmann *et al.*, Shiraishi *et al.* in view of Ozawa *et al.*

4. Claims 9 and 16 are unobvious over Hellmann *et al.* in view of Ozawa *et al.* in view Shiraishi *et al.* in view of Ozawa *et al.* further in view of Heaps *et al.* and Corcoran *et al.*

Claim 9 is dependent on Claim 2 and provides that the base coating composition is a water based composition. Claim 16 is dependent of Claim 3 and also provide that the mono coat composition is a water based composition. Heaps *et al.* merely states that water based compositions can be used in place of solvent based compositions but does not make up for any of the deficiencies of the aforementioned references of Hellmann *et al.*, Ozawa *et al.* and Shiraishi *et al.* Corcoran *et al.* merely states that a base coat can be either a water borne or solvent borne composition but does not make up for any of the deficiencies of the above cited references that have been fully discussed and distinguished over. Since Claims 9 and 16 are dependent on Claims 2 and 3 respectively and these claims

Serial No. 10/634,330
Docket No. FA1144 US NA

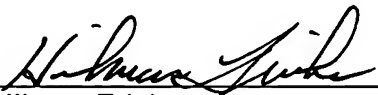
have been argued and distinguished from the aforementioned references, Claims 9 and 16 should also be considered allowable.

VIII. CONCLUSION

For the reasons set forth above, the Board is respectfully requested to reverse the final rejection of pending Claims 2–6 and 8-18 and indicate allowability of all claims.

Please charge any fee due which is not accounted for to Deposit Account No. 04-1928 (E.I. du Pont de Nemours and Company).

Respectfully submitted,

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CLAIMS APPENDIX

2. Method for painting plastic substrates, comprising the steps:
1. applying a base coat layer consisting of a colour-and/or effect-imparting base coat directly to the plastic substrate,
 2. evaporating and/or curing the base coat layer thus obtained,
 3. applying a clear coat layer consisting of a transparent clear coat to the base coat layer obtained,
 4. curing the clear coat layer obtained, optionally together with the base coat, wherein the applied colour- and/or effect-imparting base coat comprises
 - A) 30 to 90% by weight of a conventional base coat composition, comprising
 - Aa) at least one binder selected from the group consisting of polyurethane, acrylated polyurethane, polyacrylate, polyester, acrylated polyester and alkyd resins and any combinations thereof,
 - Ab) at least one colour and/or effect pigment,
 - Ac) at least one organic solvent and/or water and
 - Ad) optionally conventional paint additives and
 - B) 10 to 70% by weight of an adhesion-promoting composition B), comprising
 - Ba) at least one ethylene vinyl acetate copolymer,
 - Bb) at least one chlorinated rubber,
 - Bc) at least one chlorinated polyolefin and
 - Bd) optionally organic solvents and/or water and conventional paint additives,
- wherein the sum of the portions of components A) and B) makes up 100% by weight;
- wherein in step (1) of applying the base coat layer consisting of a colour-and/or effect-imparting coating composition consists of applying a colour-and/or effect-imparting coating composition containing the adhesion-

promoting composition B) directly to the plastic substrate and subsequently applying a layer of a colour- and/or effect-imparting coating composition which does not contain the adhesion-promoting composition B).

3. Method for painting plastic substrates, comprising the steps:

1. applying a pigmented monocoat finish layer consisting of a colour- and/or effect-imparting coating composition directly to the plastic substrate and
2. curing the top coat layer thus obtained,

wherein the applied colour- and/or effect-imparting monocoat finish comprises

A) 30 to 90% of a conventional monocoat finish composition, comprising

Aa) at least one binder selected from the group consisting of polyurethane, acrylated polyurethane, polyacrylate, polyester, acrylated polyester and alkyd resins and any combinations thereof,

Ab) at least one colour and/or effect pigment,

Ac) at least one organic solvent and/or water and

Ad) optionally conventional paint additives and

B) 10 to 70% by weight of an adhesion-promoting composition B), comprising

Ba) at least one ethylene vinyl acetate copolymer,

Bb) at least one chlorinated rubber,

Bc) at least one chlorinated polyolefin and

Bd) optionally organic solvents and/or water and conventional paint additives,

wherein the sum of the portions of components A) and B) makes up 100% by weight;

wherein in step (1) of applying a pigmented monocoat finish layer consisting of a colour- and/or effect-imparting coating composition consists

of applying a colour- and/or effect-imparting coating composition containing the adhesion-promoting composition B) directly to the plastic substrate and subsequently applying a layer of pigmented monocoat finish layer consisting of a colour- and/or effect-imparting coating composition which does not contain the adhesion-promoting composition B).

4. Method according to claim 2, wherein the colour- and/or effect-imparting coating composition comprises 35 to 80% by weight of the conventional colour- and/or effect-imparting coating composition A) and 20 to 65% by weight of the adhesion-promoting composition B), wherein the sum of portions of components A) and B) makes up 100% by weight.
5. Method according to claim 2, wherein the colour- and/or effect-imparting coating composition comprises 40 to 70% by weight of the conventional colour- and/or effect-imparting coating composition constitution A) and 30 to 60% by weight of the adhesion-promoting composition B), wherein the sum of portions of components A) and B) makes up 100% by weight.
6. Method according to claim 2, wherein the adhesion-promoting composition B) comprises
 - Ba) 1.0 to 10.0% by weight of at least one ethylene vinyl acetate copolymer,
 - Bb) 0.5 to 10.0% by weight of at least one chlorinated rubber,
 - Bc) 1.0 to 10.0% by weight of at least one chlorinated polyolefin and
 - Bd) 70.0 to 97.5% by weight of organic solvent andoptionally, conventional paint additives, wherein the sum of the portions of components Ba) to Bd) makes up 100% by weight.

8. Method according to claim 2, wherein the colour- and/or effect-imparting coating composition is a solvent-based coating composition.
9. Method according to claim 2, wherein the colour- and/or effect-imparting coating composition is a water-based coating composition.
10. Method according to claim 2 for painting plastics in vehicle painting.
11. A plastic substrate coated according to the process of claim 2.
12. Method according to claim 3, wherein the colour- and/or effect-imparting coating composition comprises 35 to 80% by weight of the conventional colour- and/or effect-imparting coating composition A) and 20 to 65% by weight of the adhesion-promoting composition B), wherein the sum of portions of components A) and B) makes up 100% by weight.
13. Method according to claim 3, wherein the colour- and/or effect-imparting coating composition comprises 40 to 70% by weight of the conventional colour- and/or effect-imparting coating composition constitution A) and 30 to 60% by weight of the adhesion-promoting composition B), wherein the sum of portions of components A) and B) makes up 100% by weight.
14. Method according to claim 3, wherein the adhesion-promoting composition B) comprises
 - Ba) 1.0 to 10.0% by weight of at least one ethylene vinyl acetate copolymer,
 - Bb) 0.5 to 10.0% by weight of at least one chlorinated rubber,
 - Bc) 1.0 to 10.0% by weight of at least one chlorinated polyolefin and
 - Bd) 70.0 to 97.5% by weight of organic solvent and

optionally, conventional paint additives, wherein the sum of the portions of components Ba) to Bd) makes up 100% by weight.

15. Method according to claim 3, wherein the colour- and/or effect-imparting coating composition is a solvent-based coating composition.

16. Method according to claim 3, wherein the colour- and/or effect-imparting coating composition is a water-based coating composition.

17. Method according to claim 3 for painting plastics in vehicle painting.

18. A plastic substrate coated according to the process of claim 3.

Serial No. 10/634,330
Docket No. FA1144 US NA

EVIDENCE APPENDIX

None

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5 Topcoats for the Automotive Industry

U. Poth

5.1 Definitions

Topcoats have as their main target to provide stability of the coating system against mechanical and chemical attack and to build an appealing effect. To fulfill all these aims, topcoats can consist of different layers. Whereas the traditional, so called solid colour topcoats consists of only one layer, today most of the metallic topcoats consist of two layers, the metallic basecoat and a clearcoat. Based on the experience with this two-layer system, there is a trend to apply solid colour topcoat systems in two layers as well. For special high quality topcoat systems there is the use of a solid colour precoat, which is applied before the topcoat to provide optimum smoothness and colour appearance. Usually, for the application of automotive coating systems there are three stoving processes: for the primer, the primer surfacer and the topcoat system. In the case of using a solid colour precoat four stoving times are required.

While the layer of primers for automotive coatings have a thickness of 18–23 μm (0.71–0.91 mils), the layer of primer surfacers have approx. 35 μm (1.38 mils), the solid colour topcoats have ca. 40 μm (1.57 mils), the metallic basecoats have 12–15 μm (0.47–0.59 mils) and the clearcoats have approx. 40 μm (1.57 mils), see Figure 5.1 [5.1].

Repair coats [5.2] are used for cars after any damage to the car body or in the case when an old coating system is no longer good in appearance or resistance. Repair coating systems consist of primers, primer surfacers, topcoats (in the special meaning of solid colour topcoats), basecoats and clearcoats ('after market repair'). The main difference between the OEM systems and the repair coats is the application method and more specifically the film building conditions. While the OEM topcoats will be stoved after spray application in tunnel ovens at temperatures of 120–150 °C (248–302 F) to build films with optimum properties, repair topcoats have to build resistant coat films at ambient temperatures or possibly at temperatures up to 60 °C (140 F). Therefore, the contents of repair coats are different to those of OEM coat systems.

If this damaging occurs during the coating process in the application line, the quality controller in the car plant can decide to run a repair coat application for a small part of the car or for the total car body. In the latter case the repair coat application will run under the same conditions as in the first coating process ('high-bake-repair' on line). If any damage to the coated car body is observed in a later state of the car construction and it is necessary to repair the coating system, the application of a repair coat runs always at temperatures about 80–90 °C (176–194 F). For this so called 'low-bake-repair' a special coating system has to be used.

Solid colour	Metallic
Solid colour topcoat approx. 40 μm (1.57 mils)	Clearcoat approx. 40 μm (1.57 mils)
	Basacoat 12 - 15 μm
Primer/surfacer approx. 35 μm (1.39 mils)	
Electrocoat primer 18 - 23 μm (0.71 - 0.91 mils)	
Substrate: steel and inhibition layer	

Figure 5-1. Layers of automotive coating systems.

Additionally there is an increase of the use of plastic parts in the construction of car bodies.

Coatings for plastic parts are quite different from those for the steel parts of a car body (see Chapter 6). Plastic parts can not be heated to higher temperature without loss of properties. Therefore topcoats for these parts are applied separately from the car body and the conditions of film building are at lower temperatures, normally 60–80 °C (140–176 F) in some special cases higher (max. 120 °C, 250 F) [5.3]. Therefore topcoats for plastic parts are related to repair topcoats, but one has to achieve a much higher flexibility for this type of topcoat.

5.2 The Development of the Different Automotive Topcoat Systems [5.4] (see Chapter 1)

The coating materials of the first cars consisted of air drying binder systems based on vegetable oils and resins: rosin and copals. Copals are semifossil resins of trees which grew in the tropics [5.5]. In England, this coating technology, based on the combination of vegetable oils and copals in a hot blend process, was developed to a high quality. For the coating process 20 separately painted coat layers are required and up to 3 weeks work time. In the twenties the demand for automotive cars increased rapidly and production assembly lines were invented and developed. Topcoats based on cellulose nitrate as a film building vehicle were used. Cellulose nitrate was combined with plasticisers, and the coating systems which consisted of this combination performed fast drying at ambient conditions and had good appearance [5.6].

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I. Industrial chemistry

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661

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and second primers prevent corrosion of the metal surface. The pigments and extenders allow the primers to react with ions (Cl^- and SO_4^{2-}) that diffuse into the film from the atmosphere. The pigmented organic film also forms a barrier against humidity that may otherwise initiate a corrosive process.

Heavy-metal pigments (mainly lead pigments) and zinc chromates were used successfully in earlier decades. These pigments are now being replaced by nontoxic pigments (see Section 11.3.1, and \rightarrow Pigments Inorganic).

The first and second topcoats build up the necessary dry film thickness and protect the entire coated construction against the adverse influence of the atmosphere.

Binders based on linseed oil and other oils have been used for many years in anticorrosive primers. Alkyd binders, especially those with high fatty acid contents, perform similarly. The main disadvantages of these binders is their limited chemical resistance and their slow drying.

Chlorinated rubber and poly(vinyl chloride) (PVC) resins allow the formulation of coatings with good chemical resistance. They are therefore used for steel constructions in chemical plants. Since they are not resistant to many organic solvents, they should not be used in oil refineries or plants handling solvents. The undesirable fact that these binders contain halogens in high amounts is responsible for their decreasing use. Overspray of chlorinated rubber and PVC paints and contaminated blasting materials produced after removing old paint cause severe problems in waste incineration plants (generation of hydrochloric acid), as well as in waste disposal areas (pollution of soil and water).

Epoxy resins cured with aminoamide resins or amine adducts are often used for large metal constructions. Paints based on these resins are normally applied in four layers. Epoxy coatings form films that are resistant to organic solvents and a wide range of chemicals. Epoxy coatings are currently used for the majority of steel and aluminum constructions, but are also suitable for use on other construction materials (e.g., concrete). They can protect buildings in chemical plants and nuclear power plants. Epoxy coatings are less susceptible to deterioration by radiation than other organic films, and are also resistant to decontaminating chemicals (usually aqueous detergent solutions) used to remove radioactive dust from walls and other surfaces in nuclear power plants.

Heat-resistant coatings have silicone-resin binders. Pigments for such paints are zinc dust, flakes of aluminum or stainless steel, titanium dioxide, or silicon carbide. Such paints can withstand temperatures up to 600°C.

Paints with inorganic binders are also used for corrosion protection of steel constructions. These paints are based on organic silicates which are soluble in mixtures of alcohols or other water-miscible solvents (see Section 2.15.2). Ethyl silicate is often used and mostly pigmented with zinc dust. Zinc-rich primers and single coats are available as one- or two-pack products. Zinc-rich ethyl silicate paints dry to form inorganic films that are very durable even under adverse atmospheric conditions, (e.g., onshore and at sea). These coatings have excellent resistance to oil, solvents, and mechanical impact, and are therefore used on drilling stations, oil rigs, and ships. Since zinc-rich silicate coatings are heat resistant, they are also used in hot areas of iron works, coal mines, and coking plants.

Heavy-duty coatings are often still applied manually with brushes or rollers that completely wet the metal surface; holes and pores are filled with paint. This is especially important when old, partially rusted constructions are repainted after sanding. Brushing and rolling, however, only allow a slow working speed. Larger surface areas must be painted with airless spraying equipment.

11.2. Automotive Paints

11.2.1. Car Body Paints

Cars are coated to achieve maximum, long-lasting corrosion resistance. Cars must also be given an optimum appearance that lasts for many years. Long-lasting color and gloss retention as well as resistance against cracking (especially in clearcoats of two-coat metallics) are therefore necessary. Topcoats of automobiles must withstand solar radiation and atmospheric pollution (e.g., acid rain and soot from oil combustion). Aggressive chemicals (e.g., road salts and cleaning agents containing detergents) can damage the coating if they come into contact with the car surface. Furthermore, small stones cause heavy impact on automobile surfaces and corrosion via chipping.

Large numbers of cars are manufactured on fast-running assembly lines. The paints must

therefore be applied with highly efficient equipment, and must dry very quickly. The paint products are classified as primers, intermediate coats (also called fillers or surfacers), and topcoats (or finish). The primers and fillers are designated as the undercoating system.

Car paints are cured with heat in special oven lines. Electrodeposition coatings (used as anticorrosive primers) contain only small amounts of volatile organic compounds (VOC), whereas intermediate and topcoats release considerable amounts of VOCs. Intermediate coats based on waterborne resins have been developed to decrease VOC emission and are already being used in some automotive plants. Basecoats, as part of base-clear topcoat systems, contain very high amounts of volatile organic solvents. Waterborne basecoats were developed more recently to lower this source of solvent emission. Some car manufacturers are operating pilot lines with the aim of introducing waterborne basecoats into their production processes. Many car producers in the United States and Europe have already switched their topcoat lines over to waterborne basecoats [11.3].

Pretreatment. Various metals are used for manufacturing car body shells: steel, galvanized steel, aluminum alloys, and zinc-rich precoated steel. The surfaces of these metals are routinely contaminated with oils, drawing lubricants, dirt, and assembly residues (e.g., welding fumes). The body shells are pretreated to remove these contaminants and to obtain a well-defined, homogeneous surface that has the necessary properties for adhesion of primers. Pretreatment includes surface cleaning and formation of a phosphate conversion coat on the shell surface (see Section 8.2.1); six to nine discrete steps are involved using either spraying devices or baths. Continuous control of phosphating solutions ensures good results [11.1], [11.4].

Anticorrosive Primers. Anticorrosive primers are applied in dip tanks so that they reach all parts of the car body; dipping is a fast method of application. The standard method for application of primers is electrodeposition. Anodic electrodeposition paints were used when the electrocoating technique was first applied, but cathodic electrodeposition is now predominant because it provides better corrosion protection.

The binders for cathodic electrodeposition are epoxy resin combinations dispersed in water (see Section 3.8). Advantages of anticorrosive electrocoatings include excellent corrosion resistance at a dry film thickness of ca. 20–30 μm . Electrocoats are stoved at 165–185°C to obtain films with the desired properties. The paint industry is now developing electrocoats that can be cured at lower temperatures (140–150°C). Electrocoating produces a homogeneous film that covers the entire car body surface, including recesses and cavities.

Although the dry film thickness on the metal edges is somewhat lower, these areas are still efficiently protected against corrosion. The ultrafiltration technique results in a very high transfer effect and a uniform coating: paint solids from the bath are deposited on the metal surface without loss. Since electrodeposition paints have a low organic solvent content, air pollution is low. The dip tank contents are not flammable, which reduces insurance costs [11.5].

Intermediate Coats. Intermediate coats (fillers) are applied between the anticorrosive primers and the topcoat systems. They provide good filling and flowing layers which are normally smoothed by sanding. Oil-free polyesters are used as binders for fillers. They react with blocked isocyanates in 20 min at 165°C. Their high flexibility gives the whole coating system a highly effective mechanical (stone chip) resistance.

Fillers are applied with electrostatic spraying devices (fast-rotating bells) to give dry film thicknesses of about 40 μm . Waterborne fillers with polyester-melamine binders (primer surfacers) have been developed to reduce the volatile organic content. They yield a film thickness of 30 μm after a prereaction time of 10 min at 100°C and a reaction time of 20 min at 165°C. The properties of the films are similar to those formed by solventborne paints. More recently, waterborne fillers based on blocked isocyanates have been developed. Field trials have shown that their mechanical resistance is very good.

Topcoat Systems. Topcoats form an important part of the protection system of the car body surface, but are much more important for decoration. The basic requirements for a car topcoat are:

- 1) Full, deep gloss (wet-look)
- 2) Highly brilliant metallic effects
- 3) Long-lasting resistance against weather and chemical influences
- 4) Easy to polish and repair

Topcoats based on nitrocellulose combinations with plasticizers and alkyd resins were used in the first decades of industrial car manufacturing. These were followed by thermosetting alkyd-melamine combinations, and later by thermosetting acrylics. The use of stoving enamels as thermosetting paints also accelerated production significantly. Although the properties of these coatings during application and in use were very good, their high content of volatile organic solvents had to be lowered to comply with legal restrictions.

The basecoat-clearcoat system is presently the most commonly used type of topcoat for cars because it is the standard application system for metallic colors. Today, about 70% of all cars have metallic topcoats. The basecoat-clearcoat system consists of a colored layer (basecoat) which is overcoated after a short flash-off time with a protective layer of clearcoat. Both coats are cured together at 120–140°C. The basecoat contains pigments which provide two types of finish: solid (straight) colors or metallic.

Solventborne metallic basecoats contain ca. 15% solids and ca. 85% volatile organic solvents. These solvents are not released into the atmosphere, but are converted to combustion gases in afterburners. To reduce emission of organic solvents from this source, waterborne basecoats have been developed.

Waterborne basecoats with higher solids contents are now available: metallic basecoats contain about 18 wt % solids and solid (straight) color basecoats 25–40 wt %. The solvent in waterborne paints is not pure water; about 15% of organic solvents is still needed as a cosolvent for proper film formation. Metallic basecoats are applied at a DFT of 15 µm, solid color basecoats at a DFT of 20–25 µm.

Basecoats are sprayed in two layers. The first layer is sprayed electrostatically with high-speed rotation bells, the second layer is sprayed with compressed air to achieve proper orientation of the aluminum particles in metallic paints. The basecoat is then dried for 3–5 min in a warm air zone at 40–60°C.

A final layer of clearcoat is applied with electrostatic high-speed rotation bells [11.3], [11.7]

to protect the system against atmospheric influences, including wear and tear during use.

Alkyd-melamine clearcoats with an approximate solids content of 50% contain UV-absorbing agents to prevent deterioration in extreme climates.

Some car manufacturers use clearcoats with acrylic binders that are cured with aliphatic isocyanates. Their chemical and mechanical properties are better than those of alkyd-melamine clearcoats. Solid contents are as high as 58%.

Car Repair Paints [11.1]. Repair paints are used in considerable amounts for refinishing cars. Since repair shops cannot provide the same facilities as those of car manufacturers, repair paints are dried at ambient temperature or elevated temperature up to 80°C (metal temperature). Alkyd repair paints and nitrocellulose paints were standard materials, but two-pack acrylate-isocyanate refinish paints are now more common. Their properties are similar to those of the original car coatings (long-lasting gloss and color, mechanical and fuel resistance). Car refinish paints are available in a wide range of colors, solids as well as metallics. They are often supplied to shops and retailers as mixing schemes.

Paint systems for car repair comprise anticorrosive primers, putties, intermediate coats, and topcoats; repair coatings applied to refinished cars have similar durabilities to those of the originally manufactured coating systems.

11.2.2. Other Automotive Coatings

The properties of coating systems used for car components differ considerably from those of systems used for exterior car surfaces. Color is not important (and is mainly black or gray), but anticorrosive properties similar to those of car body coatings are required. Since car components are produced in large numbers, coatings are commonly baked at high temperature to ensure a high reaction rate and rapid film formation.

Wheels are electrocoated; engine blocks are coated with heat-resistant, usually waterborne materials. Other parts (e.g., steering equipment and shock absorbers) are painted with two-pack, one-coat epoxy systems that are usually solvent-borne; use of waterborne systems is, however, increasing.

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